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Palomar Engineers

PO Box 462222, ESCONDIDO CA 92046

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RFI KIT

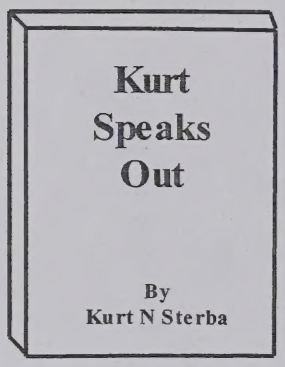
The RFI kit is designed to cure most household interference problems. There are ferrite beads for telephones, stereos, TV, VCR, computers and most other electronic equipment that is plagued with RF interference.

The included Tip Sheet describes how to go about using the beads in each case. The beads are easy to use, don't require modification of the protected equipment and work in almost all cases, even when plug-in filters fail.

RF INTERFERENCE KIT

Includes one dozen FB-63-77 beads and two each F87-43, F87-77, F114-43, F114-77, FSB-1/4 and FSB-1/2. Plus full instructions in the RFI Tip Sheet. A $42.50 value.

RFI-4.....$35.00
Add $8 S&H per order. Tax in CA



KURT'S NEW BOOK

Kurt N Sterba, sometimes known as "Krusty Olde Kurt" or "The Krusty One" and often as "The Masked Avenger", is fearless in exposing antenna manufacturers who lie or use deceptive numbers to inflate the gain dB's of their antennas. He also deflates those who use "new scientific breakthoughs" to explain the operation of their products. He pieces through the obfuscation of on-the-air antenna "experts" by explaining antennas, grounds, and feedlines in non-mathematical, simple English. His aim is to see that all understand the real basics of antennas, and are not taken in by the ever-prevalent, fine-sounding ad writers and other purveyors of false information.

This book contains 50 of his Kolumns from Worldradio 1990 to 2006. Read, learn, and enjoy.

Kurt Speaks Out.....$19.95

+$6 shipping US & Canada. $2.18 tax in CA.

RFI

Tip Sheet

Using Ferrite Beads to Keep RF Out Of TV Sets,Telephones, VCR's, Burglar Alarms and Other Electronic Equipment

RFI and TVI have been with us for a long time. Now we have microwave ovens, VCR's and many others devices that do wrong things when they pick up RF.

There are several ways to tackle the problem but most of them involve opening the affected equipment and adding suppressor capacitors, filters, and other circuit modifications. Unfortunately there is a serious disadvantage associated with this approach. Any modifications made to domestic entertainment equipment can — and often are — blamed for later problems that arise in it. Modifying your own equipment is not so bad, but taking a soldering iron to your neighbor's stereo is risky.

An alternative approach is to use ferrite beads to reduce the amount of RF entering the equipment. If the equipment is in a metal box, or even if it's in a plastic box, if RF is prevented from entering the box on the antenna lead, the power cable, the speaker leads, the phono pickup leads, and on any other wires entering the box, it is possible to solve the problem without any modification to the equipment. Ferrite beads just slip over the wires and stop RF from going in.

Ferrite beads are made of the same materials as the toroid cores used in broadband transformers but are used at much higher frequencies. For example, ferrite Mix 43 is used for tuned circuits in the frequency range .01 to 1 MHz. It is efficient and losses are low. But, if it is used in the 1-1000 MHz range it is lossy. So when you slip a bead of Mix 43 over a wire and there is RF in the 1-1000 MHz range going down the wire, it is just as though you put a resistor in the wire. But you did not have to cut the wire to insert the resistor; you just slip a bead over the wire. If the resistance of one bead is not enough you can add more beads or add longer beads to get more resistance. The beads, unlike a resistor, do not affect the wire at low frequencies so the audio, DC, and other low frequency components go through the wire just as though the bead were not there.

There are three bead materials in general use: Mix 77, Mix 43, and Mix 61. Mix 43 is the best for all-round use. It works from 1 to 1000 MHz. Mix 77 is a little better at the lower frequencies, so if your major problems are on 80 and 160 meters use it. Mix 61 is a little better on the higher frequencies so if your problems are mostly on two meters and up use it.

It is important to remember that the frequencies mentioned are those of the interfering signals to be eliminated; not the operating frequencies of the equipment being protected. For example: To protect a telephone operating at voice frequencies of .002 MHz we use type 43 or 77 beads to keep 14 MHZ RF out.

So when you buy beads you must specify both the physical size (FB-3, FB-8, etc.) and the material (Mix 77, Mix 43, etc.) depending on the frequency of the RF interference. FB-1, FB-3 and FB-7 have .05" holes that will slip over bare #18 gauge wire. FB-8 has a .09" hole and will slip over the insulation of #22 wire. FB-24 and FB-63 have .2" holes to go over larger wire or cable. FB-56 has a 1/4" hole to clear RG-58/RG-59/RG-58X. FB-102 and FB-124 have 1/2" holes to clear RG-8/RG-11.

Cables. So far we have talked about slipping beads over individual wires. But, in many cases, we are going to find two wire speaker cables, two wire or three wire power cables, twinlead antenna cable, and multi-wire control cables. Cable wires are close together and act just like a single wire as far as RF pickup is concerned. So the whole cable can go through the bead and this will suppress RF transmission through all the cable-wires. This is a lot easier than putting beads on each wire.

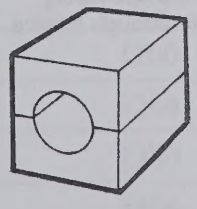
Twinlead is a special case. If you put a bead on each wire you'll kill the TV signal. But if the whole twinlead goes through a single bead, the TV signal goes on through but the RF interference is suppressed by the bead. This is because the twinlead is a transmission line to the TV signal but looks like a single wire to the RF interference.

This brings us to coaxial cable. The signal going through the coax is confined to the inside of the coax shield. But the outside of the shield acts just like any wire; it can pick up RF and that RF can be carried to the TV or monitor. Shield beads placed over the cable will suppress this interference.

Toroids. When we start talking about slipping beads over coaxial cable and multi-wire cable we see that we may need beads with pretty big holes. Also, if the cable has a molded plug on the end (like some power cords, for example) the plug has to go through the hole and we may need a very big hole indeed. Fortunately a variety of ferrite toroid cores are available with holes as big as 1.4" diameter. They are not available in all the same materials as beads but in similar ones. As a guide when specifying toroids for RF suppression:

Mix 43 is the best for all-round use. It works from 1 to 1000 MHz. Mix 77 is a little better at the lower frequencies, so if your major problems are 80 and 160 meters use it. Mix 61 is a little better on the higher frequencies so if your problems are mostly on two meters and up use it.

After you put that big plug through the toroid hole you'll find that the toroid fits the cable very loosely. Don't worry. It will still work fine. If there is room to do it, loop the cable around and run it through the toroid again. Do this as many times as you can. Each turn is just like adding another toroid. And, using the big Mix 61 cores, you add an inductive choke where two turns is four times as good as one turn, three turns is nine times as good, etc.



Split Beads. This is a new development to solve the problem of putting beads or toroids over cables that have big plugs on the end. They are beads that have been cut in half. You put the two halves over the cable and wrap them with tape to hold them together. The mating edges are polished smooth so the two halves mate very closely.

They are available with center holes of 1/4",1/2",6/10",and 3/4" diameter. Also for flat computer cable 2 or 2 1/2" wide.

It is important that the two halves of the split beads fit exactly together. So the 1/4" hole beads cannot be used for cables larger than 1/4". It does not matter if the cable is smaller than the hole.

Most split beads are of 43 material which is the best overall for 1-1000 MHz. FSB-3/4" is of 44 material which favors 10-1000 MHz.

Telephone Interference. The standard telephone is highly susceptible to RFI. The telephone wiring in the house and outside on poles make a large receiving antenna. And in the telephone instrument are voltage-variable resistors that act like detector diodes so nearby radio stations are clearly heard. The solution is to keep RF out of the telephone by putting ferrite beads on the telephone cable as it enters the instrument.

The plug of modular telephones will go through F82 toroids. Unplug the wire from the telephone, put it through the hole of the toroid (three or four times if there is room) and plug it back into the telephone. Or use a split bead.

Burglar Alarms. These are much like telephones in that they have extensive wiring throughout the building that acts like an antenna to pick up RF. The solution is the same: Use beads or toroids on the wire entering the electronics box to keep RF out. It also may be necessary to put beads on the 115-v AC power cord.

TV Sets. Put a bead or toroid on the power cord as it enters the set. Toroids or split beads on the antenna cable also may be needed.

VCR's. The VCR is a real RFI problem. Ferrite beads on all wires entering the VCR can eliminate RFI from most amateur bands. Bout on 80 meters even this doesn't always work. It may be necessary to shield the VCR housing to completely eliminate RFI.

Stereo. Long speaker wires can act like an antenna to pick up RF and feed it into the output of the amplifier. The amplifier's feedback circuit allows the RF to reach the input where it is rectified, amplified and then heard in the speaker. The solution is to use beads on the speaker wires just as they leave the amplifier.

RF can enter the stereo system through the power cord. Use a split bead or a toroid on the cord just as it enters the stereo.

We have been talking about keeping RF *out* of equipment. You can also use beads and toroids to keep RF *in*. That fish tank heater that makes all that racket on 80 meters is using its power cord and the house power wiring to radiate interference. A bead or toroid on the power cord right at the heater can keep the noise from entering the wiring. Computer power cords and connecting cables can be treated in the same manner. Sometimes RF comes out of a transceiver's power cable. A toroid can stop it. Or RF flows on the outside of the antenna cable, going right around your lowpass filter. Again, toroids to the rescue.

Cell Phones. Our FSB-1/4 split bead will stop any radio frequency energy from going up the cable of the hands-free accessory. Place it near the cell phone and wind the cable through it twice. Then close the cover until it snaps shut.

Computers. Computers are a part of many modern amateur radio stations. Often they are directly connected to the Transceiver for RTTY, packet and other digital modes. They also are used for contest scorekeeping and other uses. Computers generate RFI because they use digital waveforms in the high frequency band that have high harmonic content. They can cause interference throughout the shortwave band and even into VHF.

Some of the interference is radiated from the circuit boards but the most common source is interference conducted out of the computer on the many cables that connect it to its monitor, its keyboard, its printer, and the radio or its data controller interface.

To get rid of the interference, it is helpful to try to find *which* cable it's coming out of. Start by tuning in the interference and writing down the "S" meter reading. Then disconnect, one at a time, the devices connected to the computer and as you do so note any change in "S" meter level. Disconnect the printer, the modem, the keyboard, the mouse, the monitor, the data controller, and anything else connected to the computer. Hopefully this procedure will give a good clue as to where the problem lies.

If you isolate the major problem to one external device, place toroid cores or split beads over the lead from the computer. Do this right at the exit point from the computer. Also, if the affected device is itself an active generator, a monitor for example, put beads right where the leads come out of it. Watch the "S" meter for any change — this tells you if you are getting somewhere. Also, if the device has a power cord or a telephone cord put beads on them. Always remember that telephone and power wires can conduct interference outside your residence and near your antenna.

Split beads usually are the best for computer RFI. The cables have big connectors that won't go through a reasonable size toroid. Removing the connectors to slip on a toroid and then rewiring the connector is a lot of work and you might make a rewiring mistake and get into real trouble. Split beads are great! And they are effective from 1-1000 MHz. Just be sure that the two halves of the bead fit tightly together.

If a bead reduces but does not eliminate an interference signal, try more beads. If one is good, two are better. In stubborn cases add capacitors. A capacitor from a lead to ground converts the bead into a low pass filter. Use ceramic disc capacitors of .001 to .01 mfd. In a multi-wire cable one bead serves all but you will need a capacitor to ground from each wire.

Fuel Pump. The fuel pumps in some vehicles cause bad RFI. They are generally inaccessible but the problem usually can be cured by placing split beads (FSB-1/4) on the electrical line as close to the pump as possible. Excellent results have been reported using six beads on the line.

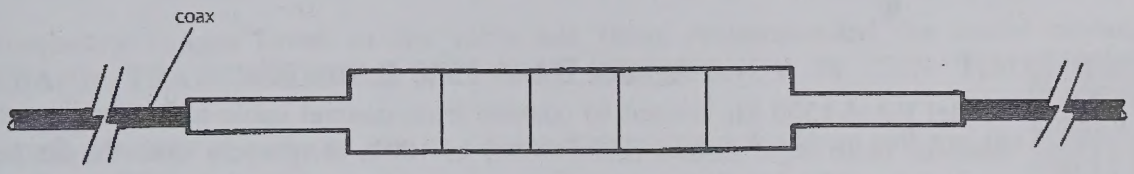
Each interference problem is different. You have to try this and then try that until you find a solution. Using the principles outlined here, ferrite beads and toroids can be extremely helpful.

Palomar Engineers

P.O BOX 462222, ESCONDIDO, CA 92046 U.S.A.

Phone: (760) 747-3343

1:1 CURRENT BALUN KITS



Baluns are used to connect **bal**anced antennas to **un**balanced transmission lines (Coaxial cable) They stop antenna currents from flowing down the outside of the cable if they are located right at the antenna. They can also be used as "line isolators" anywhere along the cable to prevent flow of induced RF and especially to keep RF out of the shack.

Palomar 1:1 balun kits are current baluns. They consist of five large ferrite beads (total length 5-1/2 inches) that slip over the coax (but will not slip over a connector). Also included are three lengths of shrink tubing to enclose the balun and hold the beads in place on the cable. They work from 3.5-1000 MHz (use two for 160 meters) and allow use of full 1500 watts power. No tools are required for installation, just a source of heat to shrink the tubing. Heat gun, lighter, matches.

Model BA-8. For use with RG-8, RG-213, 9913, LM-400 and similar size cables. Balun diameter 1 inch. Requires 9-1/2 inches of cable for installation. For use from 3.5-1000 MHz. Use two baluns for 160 meters.

Model BA-8.....$17.50
+$8 S&H (per order). Tax in Calif.

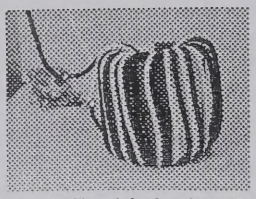
Model BA-58. For use with RG-58, RG-8X, LM-200 and similar size cables. Balun diameter 0.6 inch. Requires 9-1/2 inches of cable for installation. For use from 3.5 to 1000 MHz. Use two baluns for 160 meters.

Model BA-58.....$9.50
+$8 S&H (per order). Tax in Calif.

BA-8 & BA-58 BALUN KIT IMPEDANCE

Frequency, MHz	Impedance , Ohms
3.5	300
7	500
14	750
21	925
28	1100
50	1200
144	1300
440	1400

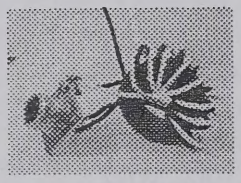
4:1 AND 9:1 BALUN KITS



Model BA-4-1500 Balun Kit

Model BA-4-1500 kit is used to convert from coaxial cable to ladder line at full amateur radio legal power (1500-watts) at 100% duty cycle over the frequency range 1.8 to 30 MHz. It gives a 4:1 impedance step-up to reduce SWR on the coax. It also can be used between a single-ended antenna tuner and ladder line and will handle high SWR in this service. The kit consists of two T200A-2 iron powder toroidal cores, two colors of #14 teflon-insulated wire, a UHF (SO-239) connector with stainless steel hardware, and an instruction manual.

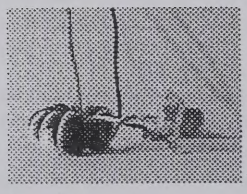
$32.50 + $8 S&H (per order)



Model BA-4-250 Balun Kit

Model BA-4-250 is a 4:1 balun kit used to translate a 50 ohm input up to 200 ohms at power levels up to 250 watts when used with a matched load. With a matched load SWR will not exceed 1.2 over the frequency range 1.8-30 MHz. The kit consists of a F140-61 ferrite toroidal core, two colors of #16 teflon-insulated wire, a UHF (SO-239) connector with stainless steel hardware, and an instruction manual.

$25.00 + $8 S&H (per order)



Model BA-9-250 Balun Kit

Model BA-9-250 is a 9:1 balun kit used to translate a 50 ohm input up to 450 ohms at RF power levels up to 250 watts when used with a matched load. With a matched load SWR will not exceed 1:1 over the frequency range 1.8 to 30 MHz. The kit consists of a F140-61 ferrite toroidal core, three colors of #16 teflon-insulated wire, a UHF (SO-239) connector with stainless steel hardware, and an instruction manual.

$25.00 + $8 S&H (per order)

FERRITE TOROID CORES

Ferrite toroid cores are used for low power tuned circuits and especially for wideband transformers and baluns. They have high permeability so you get high inductance with few turns.

The frequency ranges listed in the table are those recommended for tuned circuits. FOR WIDEBAND TRANSFORMERS THE TOP FREQUENCY IS TEN TIMES HIGHER.

To find the number of turns to give the desired inductance for your coil use the formula below:

$$\text{Turns} = 1000 \sqrt{\frac{\text{Desired L, (mH)}}{\text{mH/1000 turns (from table)}}}$$

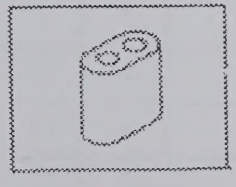
Chart showing mH per 1000 turns.

CORE SIZE	Mix 67 μ=40 10-80 MHz	Mix 61 μ=125 .2-10 MHz	Mix 43 μ=850 .01-1 MHz	Mix 77 μ=1800 .001-2 MHz	Mix 75 μ=5000 .001-1 MHz	SIZE O.D. inches	SIZE I.D. inches	SIZE HT. inches	PRICE $ (U.S.)
F-240		173	1240	2740		2.40	1.40	.50	13.65
F-140	45	140	1060	2250		1.40	.90	.50	6.25
F-114A		146	993	2340		1.14	.75	.55	4.50
F-114	25	79	603	1270		1.14	.75	.30	3.50
F-82	23	73	557	1170		.82	.52	.25	1.70
F-50B	48	150	1140	2400		.50	.31	.50	1.60
F-50A	24	75	570	1200	3000	.50	.31	.25	1.45
F-50	22	68	523	1100	2750	.50	.28	.19	1.10
F-37	18	55	420	884	2210	.37	.19	.12	.85
F-23	8	25	188	396		.23	.12	.06	.75

To order specify core size and Mix. Example: F240-61
Available in sizes that have mH per 1000 turns shown in the table.

Balun Cores

Part Number	Length	Width x Thickness	Hole Dia.	Mix	Price
BLN-24-43	.25"	.28" x .16"	.07"	43	$ .70
BLN-68-61	1.1"	.53" x .3"	.15"	61	$3.30



IRON POWDER TOROID CORES

Iron powder cores are more stable than ferrites and do not saturate as easily so they are best for tuned circuits, filters, and high power inductors. They come in different "Mixes" for use at different frequencies. For best "Q" use the Mix specified for your frequency. To find the number of turns to give the desired inductance for your coil use the formula below.

$$\text{Turns} = 100 \sqrt{\frac{\text{Desired L } (\mu H)}{\mu H \text{ per 100 turns (from table)}}}$$

Note: Mix 7 has lowest temperature coefficient. Use for VFO's.

Note: Mix 17 available in same sizes as Mix 12, μ=4, Blue/Yellow

Chart showing uH per 100 turns

CORE SIZE	Mix 26 μ=75 0-1 Mhz Yellow White	Mix 3 uμ=35 .02-1 MHz Grey	Mix 15 μ=25 0.1-3 MHz Red White	Mix 1 μ=20 .15-2 MHz Blue	Mix 2 μ=10 .25-10 MHz Red	Mix 7 μ=9 1-20 MHz White	Mix 6 μ=8.5 2-30 MHz Yellow	Mix 10 μ=6 10-100 MHz Black	Mix 12 μ=4 20-200 MHz Green White	Mix 0 μ=1 50-250 MHz Tan	SIZE O.D. Inches	SIZE I.D. Inches	SIZE Height Inches	PRICE $ (U.S.)
T-400A	2600				360						4.00	2.25	1.30	37.50
T-400	1320				185						4.00	2.25	0.65	18.75
T300A-2					228						3.04	1.94	1	15
T-300	825				115						3.05	1.93	0.50	11.00
T-250					310						2.50	1.25	1.00	15.40
T-225A					215						2.25	1.40	1.00	11.00
T-225	950	425			120		100				2.25	1.40	0.55	9.60
T-200A	1550				218						2.00	1.25	1.00	8.25
T-200	895	425		250	120		100				2.00	1.25	0.55	6.85
T-184	1640	720		500	240		195				1.84	0.95	0.71	7.25
T-157	970	420	360	320	140		115				1.57	0.95	0.57	5.50
T-130	785	350	250	200	110		96		40	15	1.30	0.78	0.44	3.45
T-106	900	450	345	325	135		116		51	19	1.06	0.57	0.44	2.75
T-94	590	248	200	160	84		70	58	32	10.6	0.94	0.56	0.31	2.40
T-80	450	180	170	115	55		45	32	22	8.5	0.80	0.50	0.25	2.10
T-68	420	195	180	115	57	52	47	32	21	7.5	0.68	0.37	0.19	1.35
T-50	320	175	135	100	49	43	40	31	18	6.4	0.50	0.30	0.19	1.00
T-44	360	180	160	105	52	46	42	33	19	6.5	0.44	0.23	0.16	.90
T-37	275	120	90	80	40	32	30	25	15	4.9	0.37	0.20	0.13	.85
T-30	325	140	93	85	43		36	25	16	6.0	0.30	0.15	0.13	.80
T-25		100	85	70	34		27	19	12	4.5	0.25	0.12	0.10	.60
T-20		90	65	52	27		22	16	10	3.5	0.20	0.09	0.07	.60
T-16		61	55	44	22		19	13	8	3.0	0.16	0.08	0.06	.50
T-12		60	50	48	20		17	12	7	3.0	0.12	0.06	0.05	.50

To order specify core size and mix. Available in sizes that have μH per 100 turns shown in table.

FERRITE BEADS

Ferrite beads are used for RF decoupling and parasitic suppression. When placed over a coaxial cable they prevent RF from flowing on the outside of the shield but do not affect the signal inside the cable. Mix 43 works from 1-1000 Mhz. Mix 77 favors 1-7 MHz. Mix 61 favors 200 MHz and up. These frequencies are those of the interfering signal to be eliminated, not the operating frequencies of the equipment to be protected.

BEAD SIZE	MIX 61	MIX 43	MIX 77	MIX 75	O.D. inches	I.D. inches	Length inches	Price each U.S. $
FB-1	X	X	X	X	.14	.05	.12	.23
FB-2	X	X	X		.08	.04	.15	.23
FB-3	X	X	X		.14	.05	.23	.23
FB-7			X		.14	.05	.50	.23
FB-8	X	X	X		.30	.09	.30	.35
FB-15		X			.14	.06	.13	.23
FB-18	X	X	X		.20	.06	.44	.40
FB-20		X			.25	.125	.50	.40
FB-24		X	X		.38	.20	.19	.40
FB-63		X	X		.38	.20	.41	.46
FB-56		X			.56	.25	1.12	1.65
FB-102		X			1.02	.50	1.12	3.30

To order specify bead size and mix. Available in sizes and mixes marked X in table.
FB-56 will go over RG-58, RG-8X, LM-200. FB-102 will go over RG-8, RG-213, 9913, LM-400.

SPLIT BEADS

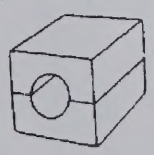
Often it is difficult to slip beads on a cable because of a plug or connector. Split beads solve this problem. They come in two halves that fit over the cable. A plastic snap cover holds the two halves together and holds the assembly on the cable.

FSB-1/4 For 1/4" cable (RG-58, RG-8X), 43 Mix for 1-1000 MHz, 1-1/4" long.....**$2.75 each**

FSB-1/2 For 1/2" cable (RG-8, RG-213), 43 Mix for 1-1000 MHz, 1-1/4" long.....**$5.50 each**

FSB-6/10 For cables up p 6/10" diameter, 43 Mix for 1-1000 MHz, 5/8" long.....**$3.50 each**

FSB-3/4 For cables up to 3/4" diameter, 44 Mix for 10-1000 MHz, 1-5/8" long.....**$9.00 each**



ORDER FORM

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NAME_____ CALL_____

STREET_____

CITY_____ STATE_____ ZIP_____ COUNTRY_____

HOW MANY	DESCRIPTION	PRICE EACH	TOTAL PRICE

Charge to Mastercard or VISA

Charge to American Express

Expiration Date

Month_____ Year_____

AMOUNT FOR GOODS	
SHIPPING/HANDLING	$8.00
CALIF. CUSTOMERS ADD 8-3/4% SALES TAX	
TOTAL AMOUNT ENCLOSED	

Note: $8.00 S&H is for total order U.S. andCanada. Other countries we charge actual airmail postage.

1-11